

Moored Observations of Internal Waves in Luzon Strait: 3-D Structure, Dissipation, and Evolution

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Grant Number: N00014-09-1-0219

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LONG-TERM GOALS

We are interested in the general problems of internal waves and ocean mixing. Knowledge of these is important for advancing the performance of operational and climate models, as well as for understanding local problems such as pollutant dispersal and biological productivity. In the specific case of NLIWs, the currents and displacements of the waves are strong enough to impact undersea operations. More generally, most of the ocean's physical and acoustic environments (and particularly in straits) are severely impacted by internal waves. The research proposed here should substantially improve both our understanding and predictive ability of linear internal tide and NLIWs in Luzon Strait and the South China Sea (SCS).

OBJECTIVES

- To understand the generation mechanisms, and to better predict the arrival times, of waves that ultimately become the NLIWs that propagate westward into the northeastern SCS.
- To better understand generation and propagation of internal waves in a strongly sheared environment (the Kuroshio).
- To relate findings to the more general problem of internal waves in straits.

APPROACH

The IWISE DRI (Internal Waves in Straits Directed Research Initiative) includes an impressive combination of moored, shipboard and autonomous observations, together with remote sensing and modeling studies. Though observations in other straits such as Surigao Strait in the Philippines may be undertaken, the most intensive observations in IWISE will take place in Luzon Strait (Figure 1) during summer 2011. These will be preceded by a pilot experiment to shake out equipment, refine hypotheses and determine the best location for the main experiment.

Report Documentation Page				Form Approved OMB No. 0704-0188	
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1. REPORT DATE 2009		2. REPORT TYPE		3. DATES COVERED 00-00-2009 to 00-00-2009	
4. TITLE AND SUBTITLE Moored Observations of Internal Waves in Luzon Strait: 3-D Structure, Dissipation, and Evolution				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Washington University ,Applied Physics Laboratory,1013 NE 40th Street,Seattle,WA,98105				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 4	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

Our contribution to the effort is a 7-element array of profiling moorings (Figure 2). These feature McLane moored profilers (MP), which repeatedly transit a standard subsurface mooring wire while measuring temperature, salinity, dissolved oxygen, turbidity and velocity. These ~hourly profiles will be augmented by much faster measurements from up and downlooking 300-KHz and 75-KHz ADCP's (for velocity) and Seabird microcats and T-loggers (temperature and salinity). Turbulence will be estimated both from density overturns measured by the profiler and by micro-temperature measurements from an OSU chi-pods (Moum/Nash) mounted on the profiler and on the wire above and below. The array will serve as a “backbone” for the rest of the observations and enable determination of the 3-D structure of the internal waves generated in the Strait.

WORK COMPLETED

Work to date has focused on designing the pilot experiment, and honing intuition and hypotheses for the main experiment. I attended meetings in Honolulu (January 2009) and Chicago (June 2009) to design the pilot study. The large horizontal scales to cover, the strong currents, and uncertainty regarding the phasing and mechanisms of generation in the strait, all present challenges in designing the pilot, which will be central in the final design of the main experiment.

We volunteered to take the lead on the pilot experiment. With guidance from the other pilot PI's (Farmer, Ramp, Lien, MacKinnon, Johnston, Rainville, Nash) and the whole IWISE group, a strawman plan was arrived at which includes: 1) equipment shakeout, 2) intensive ADCP/CTD work near a generation hotspot at the eastern ridge identified in models, and 3) attempt to detect the transformation of internal tides into nonlinear internal waves. We are currently on the *R/V Revelle* schedule for a 30-day cruise during the Typhoons cold wake waiting period in late August 2010. We are working closely with modelers (especially Jody Klymak, Harper Simmons, and Oliver Fringer) to improve our understanding of the generation and, hence, further refine the pilot plan.

RESULTS

We have no scientific results yet.

IMPACT/APPLICATIONS

TRANSITIONS

RELATED PROJECTS

Within IWISE, we are working closely with modelers (sepecially Klymak, Simmons, and Fringer), as well as with other observational groups (Moum/Nash in developing the moored profiler chi-pod, and Nash/Moum in LADCP/CTD measurements during the pilot and main experiment).

With regard to other DRIs, the understanding of the generation process of the NLIW, which is the goal of IWISE, fills a major void in the NLIWI DRI. In addition, the measurements taken during the Typhoons measurement period will benefit that DRI.

REFERENCES

PUBLICATIONS

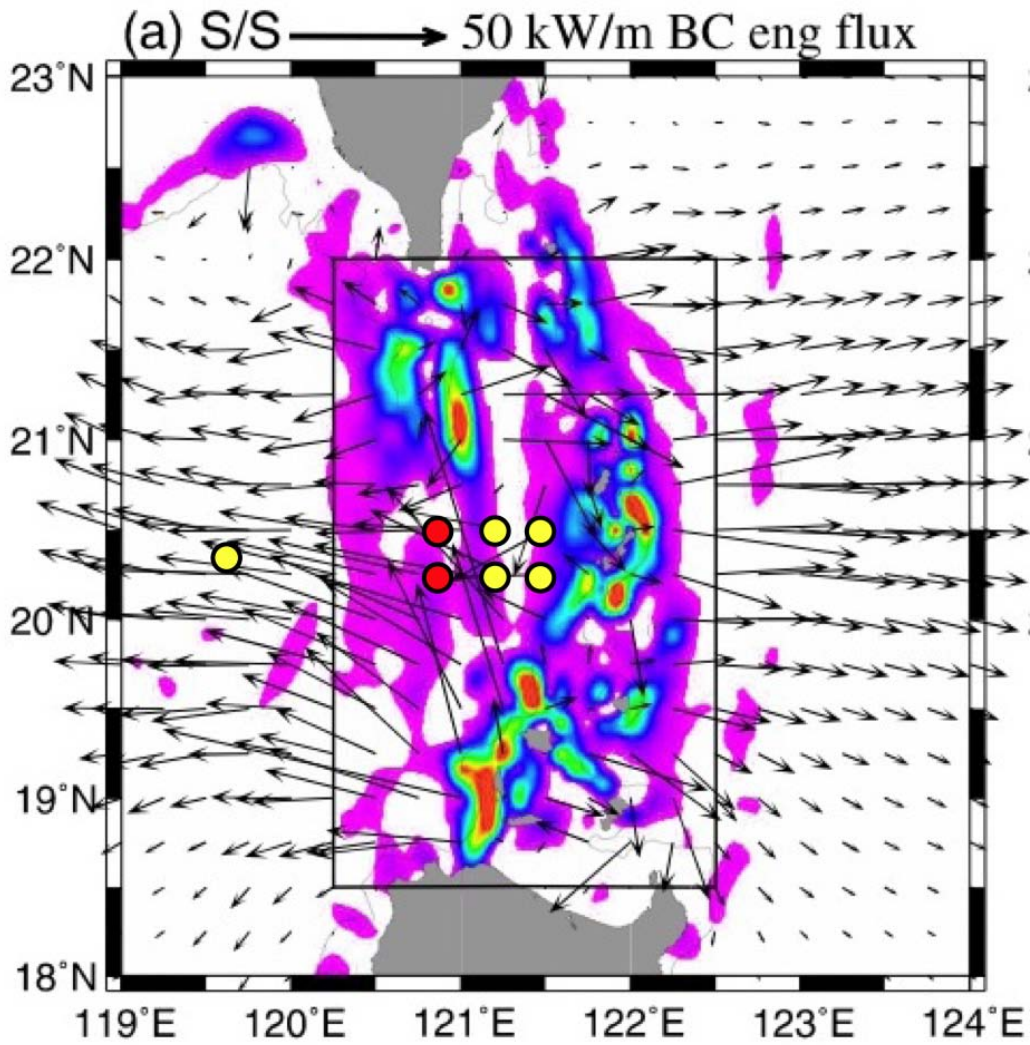
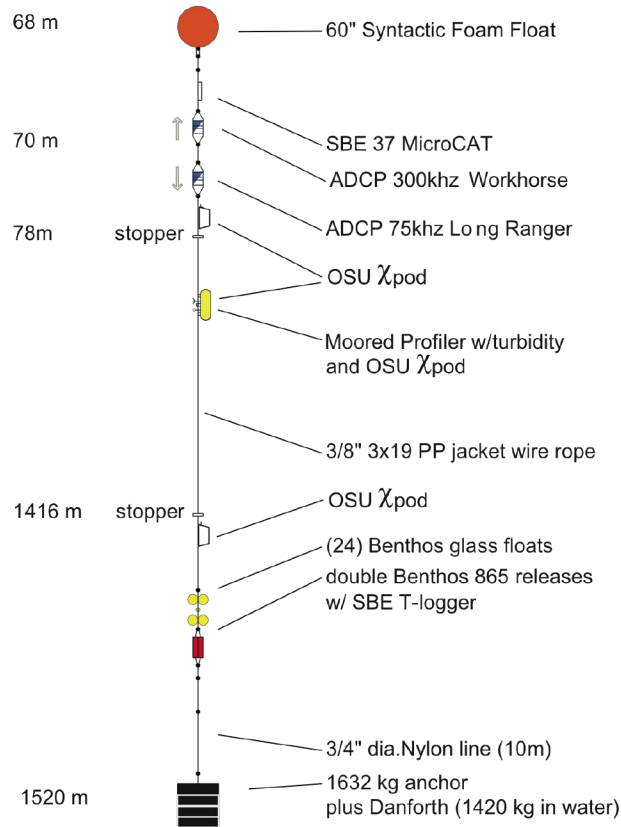


Figure 1: Tidal conversion (colors) and energy flux vectors at spring tide (from Jan et al., 2008) also showing the preliminary mooring array configuration (circles, red with OSU Chi-pods). Note that the array spans a region of both expected strong off-ridge fluxes and internal tide generation.

a)



b)

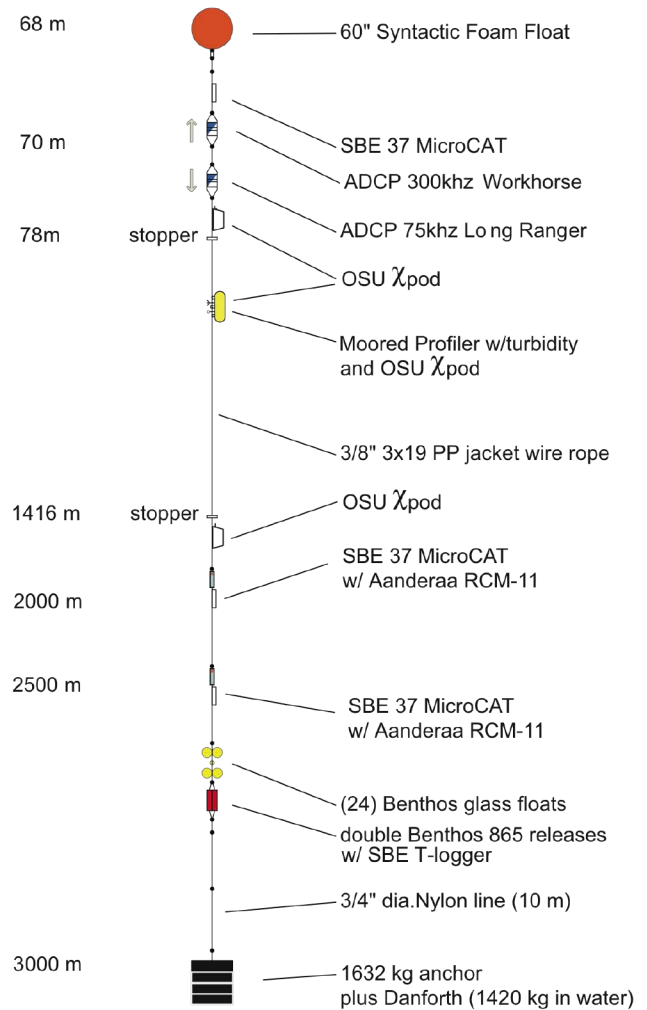


Figure 2: Sample mooring diagrams for 1500 m depth (left) and 3000 m (right), showing the MP, upward (300kHz) and downward(75kHz) looking ADCPs, OSU chi-pods, and SBE MicroCAT and T-logger.